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PACIFIC COAST ELECTROCHEMICAL POSSIBILITIES

COMPARED WITH NORWAY AND SWEDEN

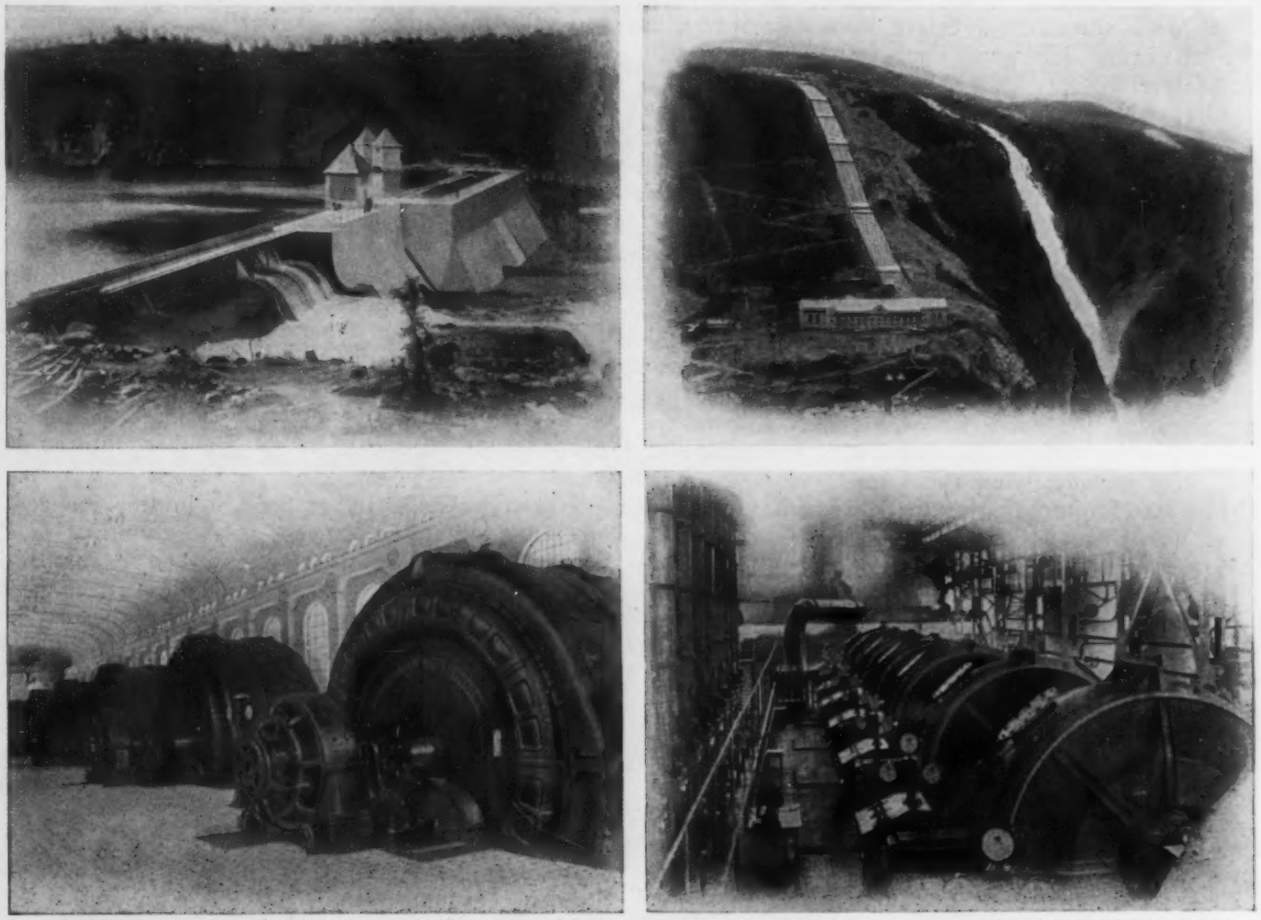
BY J. W. BECKMAN.

(Here are facts which prove that California, Oregon and Washington have all the requisites for an electrochemical development which should surpass that in the Scandinavian peninsula. The article is slightly condensed from a paper read before the San Francisco Section of the American Chemical Society, Jan. 22, 1916. The author is chemical engineer with the Great Western Power Co. at San Francisco.—The Editor.)

Sweden and Norway, notwithstanding their older civilization and different position on the globe, are in many respects similar to Washington, Oregon and California. Those widely separated portions of the world are alike in size, in population and in amounts of standing timber. Most of the water power sites in each section are located in inland mountains, some distance from the comparatively flat sea coast, though in Norway, as in British Columbia and Alaska, there are many possible developments on tide water.

The electrochemical possibilities of Sweden and Norway are great for two reasons—an abundance of cheap power and comparatively cheap labor.

In Norway, 7,500,000 h.p. are available at present, of which 500,000 h.p. is developed, and an additional million horsepower is under development. When all



The Rjukan Falls Development in Norway, Employing the Birkeland-Eyde Process of Air Nitrate Production and showing (1) The Forebay, (2) Pressure Pipe Power House and Falls, (3) 18,500 k.v.a. Generators, and (4) Ovens in which the Arc Oxidizes the Nitrogen.

this power is developed it will amount to about 20 per cent of all available power. The largest present, single operating installation is at Rjukan, where 131,000 h.p. has been developed and 119,000 h.p. is being developed. There are two possible 240,000 h.p. developments, neither of which is projected. Many of the installations are inaccessibly located in the interior, involving special means of transportation to reach them, often through sections where power transmission is impossible, partly due to the nature of the country, and partly to climatic conditions.

In Sweden, conditions are materially different. The heads are comparatively low and the nature of the country makes long transmission lines possible. The available power in Sweden is 6,200,000 h.p., of which at present 900,000 h.p. are developed, about 15 per cent of the total available. The largest single development is that of the Swedish government at Trollhattan, in the southern part of the country, where a total of 80,000 h.p. is obtainable. Most of the Swedish developments are low head plants with small capacity.

In the three Pacific Coast states about 11,000,000 h.p. of which 7 per cent, or 831,000 h.p. have been developed. Most of the developments are high heads, 500 ft. or more. Among the most noted proposed low-head developments is at The Dalles on the Columbia River, where about 800,000 h.p. could be delivered. More than half this amount could be supplied twelve months of the year. The remaining power could be counted on for eight to eleven months of the year. In California the Great Western Power Company, in spite of having developed some 100,000 h.p., is still able to develop some 500,000 h.p. more.

On account of local and climatic conditions in the coastal states, long distance transmission is easy and comparatively cheap. As the population is centered in the large valleys and along the coastal districts, the necessary length of power lines from generating stations, located in the mountains, to the consuming districts, are comparatively short, and the lines with few exceptions do not exceed 200 miles.

Power and Labor Costs.

The cost of hydroelectric power is really a question of bookkeeping, and since each plant has its pet way of calculating costs, it is impossible to compare average power costs, not knowing how much, or how little, they include, what the interest rates are, etc. When a standard accounting method is adopted by all power plants throughout the world, then cost comparisons, per horsepower, may have some meaning.

When an industry develops its own power source, the bookkeeping method can absolutely hide the actual cost of the power. On this account I am extremely skeptical as to the low figures of $3 or even less quoted for the power utilized by some industries in Norway. The prices for power obtainable on the Pacific Coast close to, or at the power site, do not vary materially from those in Sweden and Norway.

The prices for which power may be purchased in those countries vary from about $6 per h.p. year, and up, provided large blocks of power are taken. In Norway with higher head developments the minimum price may be somewhat lower.

Compare these prices with that of less than $10 per h.p., quoted by the state of Oregon for power from the projected development at The Dalles, and I believe you will agree that cheap power is available here, as well as in Sweden and Norway.

Only recently has one of the large power companies on the coast entered into contract with an electrochemical company for large blocks of power on tide water at a rate similar to that which is obtainable today at Niagara Falls. Niagara Falls is 500 miles from tide water, which means a long rail haul to seaboard. Power on San Francisco Bay at the same rate means large savings in the way of transportation charges, etc.

The idea that there is an abundance of cheap labor in Sweden and Norway is to an extent a fallacy. Emigration is continuously draining the working stock of the people. The average daily wage is about $1 to $1.25. In the more specialized industries, as the electrochemical, the price of labor is somewhat higher.

Compared with the cost of labor on the Pacific Coast, the Scandinavian prices are low. But the ultimate cost of producing electrochemical products, I believe, is no higher there than here, due to higher cost of raw materials there than here.

Electrochemical Industries.

What then are the industries that have brought Sweden and Norway to the front in the eyes of the world as countries that take a foremost position in the electrochemical industries?

When artificial nitrogen fertilizers are mentioned, Norway looms up with its 200,000 h.p., exclusively devoted to that industry. Calcium nitrate and calcium cyanamide are both products made in Norway; the latter is also made in Sweden. The raw materials for these products are cheap power, the nitrogen of the atmosphere, and limestone. In case of the cyanamide, coal is also needed. In Sweden and Norway, plentiful, cheap power is available, not always in accessible places, as the large developments at Rjukan, in Norway show, located as they are in the most impenetrable part of a mountain fastness. Nitrogen is abundant; limestone is accessible in some cases, though in others involving considerable haul by rail or water. The coal is all brought in from England, which means expense of handling and in addition duty on the importations.

The Pacific Coast states are in this respect as favored, in many instances, as the countries of the Scandinavian Peninsula. Take as an example the projected development at The Dalles: deep water navigation is possible up to and beyond the proposed power site; limestone from Washington could be brought in cheaply, quarried as it is right on tide water; coal from China, and eventually from Alaska, could also be brought in and water transportation would be available for the finished product. Similar conditions can be found at other localities on the Pacific Coast.

What has been said in regard to the fertilizer industries, applies equally well to the carbide industries. Sweden consumes some 20,000 h.p. annually in carbide manufacture, and Norway consumes considerably more at the large works at Odda.

The Swedish iron is famous and well known over the world. Until quite recently Swedish iron was losing its reputation. Scarcity of charcoal followed the increasing numbers of shaft furnaces put in operation, until gradually some of the iron masters of Sweden began to substitute coke for charcoal and the common coke pig iron was obtained, with a result that the long established position held by Swedish iron in the markets of the world, was fast slipping away. Today though, it is possible to treble the number of shaft furnaces in Sweden without being obliged to use coke due to the introduction of the electric shaft furnace, where two-thirds of the charcoal, which was used exclusively for heating the charge in the furnace, is substituted by electric heat.

As the earliest blast furnaces were built in Sweden, so also Sweden first successfully solved the electric shaft furnace.

The iron industry of Sweden is located in a narrow strip seventy miles wide and 140 miles long. The approximate distance from Oakland to Sacramento. This small section of the country has brought fame to Sweden through its iron.

As time goes along and the old blast furnaces have to be replaced with new, never again will an old type furnace be placed in operation. Electrical shaft furnaces will be installed instead. There are now over a dozen of these furnaces in operation in Sweden turning out close to 50,000 tons of iron per year.

The raw materials needed in electric shaft furnace operations are cheap power, high grade iron ore, good limestone and an abundant supply of charcoal.

One million tons of charcoal are burnt in Sweden annually. Practically all of it is used in the iron industries. The charcoal is burnt all over the country, and shipped into the iron producing district by rail. The greater part of the charcoal is produced in the old fashioned way of heap-burning, though there is a strong tendency at present to substitute the heap-burning by the large unit by-product charcoal ovens, of which there are over twenty plants installed and operated.

Norway is also heavily timbered, but due to great transportation difficulties charcoal is not produced in such quantities there, nor do I believe they have any electric shaft furnaces at present in operation.

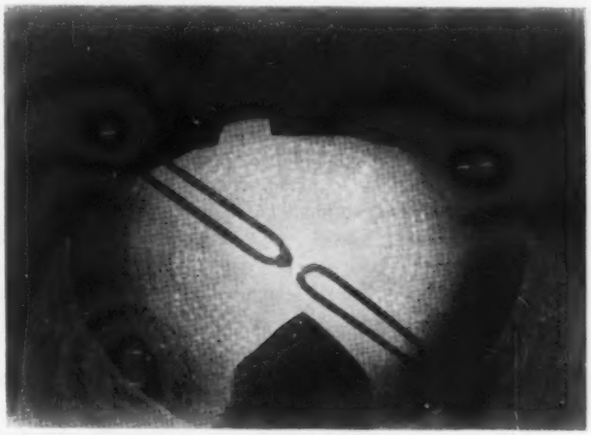
Iron ore is abundant in Sweden. Some has to be concentrated, since high content of silica means an excessive power consumption in the electric shaft furnace. The northern ores from the large famous deposits near the Arctic circle average close to seventy per cent iron, and so do the concentrates from the more centrally located deposits.

Lime-stone is available though not always in closest proximity to the shaft furnace plant.

Power is often obtained from small hydroelectric developments, where enough energy is required to operate a single furnace, or purchased from a generating station.

What then are the conditions on the Western coast of U. S. A., that would suggest the possibility of an iron industry growing up, similar to that of Sweden.

The three coastal states have practically as much timber land as Sweden; the actual board measure would be much to the advantage of these states since, due to climate and other conditions, the growth in Sweden is quite light. Incidentally it is of interest to realize that Washington, Oregon and California today contain about one-half of all the timber lands in the United States. There are twenty-eight hundred billion feet of timber in the U. S. A., while these



Electric Arc in Birkeland-Eyde Oven, the Principal Basis of this Patent.

three states have of this amount, thirteen hundred billion feet, assuring abundant supply of raw materials for charcoal burning.

By-product charcoal plants, close to the large lumber operations, should at present not only be the wise policy for lumber operators to follow, but should also give a good revenue from the refuse which at present is a decided nuisance and often a menace, and could thus supply the needed charcoal for iron reduction.

It would take many years to develop one million tons of charcoal per year on the coast, but it is interesting to note that under conditions considerably adverse to our own, this is accomplished in Sweden.

Limestone is abundant all through these states, the quality of which is suitable for smelting purposes.

Iron ores of varying qualities, some of the highest purity, and others less pure, are available at many points in California, and adjoining states.

Power close to power sites, and in the timbered districts, where charcoal could be cheaply made, is obtainable at prices which will make electric shaft furnace operations not only successful, but financially profitable.

Norway and Sweden produce small amounts of ferro-alloys. The raw mtaerials have to be imported. As an example, chrome ore is brought in from New Zealand.

The raw materials for such industries are right at hand in these states, and can be had, in many cases, practically at no cost compared with prices paid for similar raw materials brought in to Sweden and Norway.

Norway produces some aluminum from ore, part of which is imported, and part obtained from local deposits.

The Pacific Coast states have a very large supply of practically pure aluminum oxide awaiting treatment. The aluminum oxide is now in dumps, being a by-product in the potash production from alunite in Utah.

Sweden produces considerable quantities of sodium and potassium chlorate. The raw materials have to stand heavy freight charges, as they are imported from Germany. This is also the case in reference to salt used in the manufacture of caustic soda and bleach.

We are favored here by salt which is readily available, both from the water obtained through solar evaporation and from natural deposits. It may be of some interest to know that a caustic soda and bleach plant is to be built in the near future on San Francisco Bay.

Potassium chloride is to be had from Searles Lake, we hope at no distant date. Meanwhile we may be able to get this salt from various waste materials available on the Pacific Coast, which are now being absolutely neglected.

An industry of special interest, developed in Sweden, is the electric reduction of zinc. Not less than 18,000 h.p., producing close to 4000 tons of zinc per annum, are consumed in this industry. Ores containing both lead and silver, as well as zinc are used, recovering all the values.

Many of the ores of the West, which are now deemed practically worthless due to zinc content, could be advantageously treated in the electric furnace on the Pacific Coast.

Markets.

An industry can never be a success if there is no market for its products.

Sweden and Norway together, have a population of about eight million people, and since the greater part is a rural population, there is a comparatively small demand for manufactured products. Therefore, foreign markets have been sought for the products of the industries.

There is no part of the globe that is not in some way dependent on products made in Sweden and Norway. This wide market field has been developed through necessity, and necessity has forced co-operation. Commercial agencies have been formed in foreign ports through which everything from Swedish lumber and sewing machines to electrochemical products, have been sold. The different manufacturers have maintained these sales agencies jointly, and consequently the selling cost in foreign countries has been brought down to a minimum for the various products.

The nearby European markets are severely competitive, but they have been entered successfully. This has been possible by the high quality and low price of the product. Sweden and Norway, the latter especially, have learned the art of handling tramp steamers. Due to this fact freight rates for products reaching foreign markets, have been brought to a minimum.

It is equally possible for electrochemical industries, or in fact any industry, on the Pacific Coast to penetrate foreign markets. We can reach from this point over one-half of the world's population, by going west and south. Some of the markets are small, but are bound to grow, and if we miss the present opportunity, somebody else will step in and collect the harvest which legitimately belongs to us.

We should profit from what Sweden and Norway have done.

The large electrochemical developments in Norway are financed by international capitalists, involving various complex problems, while here, if the needed capital cannot be procured on the coast, projects may be jointly financed by local as well as Eastern capital. This involves at the most, a trip East with none of the complications that go with the use of foreign capital.

The Pacific Coast is endowed with raw materials that may in time revolutionize some of the large industries; take for example oil so abundantly present in California.

Doesn't it seem like an intention of fate, that large high grade iron ore deposits, hydroelectric power and oil have been placed side by side. Can't you conjure up a new type of iron reduction process, where the iron is obtained from the ores by means of electric heat, combined with the carbon and hydrogen in the oil as a reducing agent? I feel certain that the day will come when the Pacific Coast will be a factor in the iron markets of the world, due to the presence of these three agents.

Norway has about 300,000 and Sweden practically 150,000 h.p. utilized in electrochemical and electrometallurgical industries. This has not been grown over night, on the contrary they have done careful and faithful pioneer work, not only in the laboratories, but among the population, and also in the council chambers of the nation. An electrochemical atmosphere has been produced; the layman has been brought face to face with it in the perusal of his daily paper, and gradually the population has grasped the fact that (though the details were perhaps hidden to the layman), electrochemistry is one of those mystic shrines which, if approached with the proper signs known only to a few brings forth new developments and wealth.

We need an electrochemical atmosphere on the Pacific Coast. Gold mining has been the atmosphere. Everybody knows what a placer mine or a gold dredge is; the papers are full of it. The large state universities, as well as the daily papers, can assist in bringing this electrochemical atmosphere here. Without fear of being refuted, I will say that the Pacific Coast has more potential wealth in its eleven million horsepower, of which 93 per cent goes to waste today, than all the gold that ever was mined, or is still to be mined in these states.

Sweden and Norway are today looked upon as electrochemical centers. The Pacific Coast, I believe will, within the life time of most of us, be looked upon as one of the large electrochemical centers of the world, due to our being favored with abundant hydroelectric power, varied and important raw materials needed in these industries, and the men of this coast.

Electrochemistry is a young science in its present development compared with other sciences. The electrochemical industries are consequently young men's industries. Therefore young men are needed, men with the pioneer's optimistic resourcefulness and courage. But this alone is not necessary; they need a special education which the large universities of this coast are bound to give if they are not already giving it to their students. With power, raw material and men, the Pacific Coast holds a mighty future in the field of electrochemistry.

PUMPING PLANT TRANSFORMER EQUIPMENT.

By RALPH E. CUNNINGHAM.

(After pointing out the faults of early 10,000 volt indoor installations the author describes recent practice in outdoor substations. Mr. Cunningham is superintendent of electric distribution for the Southern California Edison Co., from whose magazine this article is reprinted.—The Editor.)

There have been a number of different methods used by the Southern California Edison Company for installing 10,000 volt equipment for pumping plants during the past years. The early installations were both of the indoor and outdoor type, but installed without much attention to "safety first." At that time very little experience had been gained to show the necessity of protection against the hazard of high voltage wires, and much the same methods of construction were used as had previously been used for low tension construction.

The rams horn fused air break switch was used for controlling the 10,000 volt line, both on the indoor and outdoor installations. The trouble experienced with the outdoor installation was on account of the fact that no standard outdoor type bushings were manufactured in the early days, and the ordinary bushings on the outdoor installations gave a chance of grounding the lead-in cables, due to dirt and damp weather; also the small fuses used in the horn switches would often break off due to birds or the weather.

Fig. 1—An Early Type of Indoor Installation.

Fig. 1 shows the exterior view of a typical indoor installation. The faults of the early type of indoor installations are obvious to the "safety first" advocate. The bare high tension wires, while installed at a height above ground which might be thought would ordinarily prevent trouble, were the cause of a number of serious accidents. Owners occasionally desire to paint their buildings or do other work around the building and not understanding the dangerous character of the wires, would come in contact with them, both inside and outside the building. The first step taken to do away with this risk was to use cambric insulated weather proof wire in place of bare wire. In this case, however, the horn switch was still installed within the building, and while protected in so far as possible with wire screen, there was still considerable chance of accident on account of a fuse blowing under heavy load and the arc carrying up on the horns, setting fire to the building; also there remained the possible chance of persons coming in contact with the bare horn switches.

The next improvement was to substitute for the horn switches, a pole top fused switch, installed on the first pole outside the building. With this arrangement the operator of the pumping plant can disconnect his transformers and all wiring inside the building by operating the lever at the base of the pole which controls the pole top switch, even more easily than the pulling out of the three horn switches, which were previously installed inside the buildings to be accessible. With this installation the cambric insulated wire was still used for entering the building and within the buildings up to the transformers, so that under ordinary circumstances there was very little chance of any accidents. The only possible chance of trouble would be the breakdown of the transformers setting fire to the buildings, or irresponsible parties cutting into the insulated 10,000 volt wires.

All installations up to this time had been equipped with either two or three single-phase transformers. With a view to eliminating the objectionable features of the last mentioned indoor installation, also in the attempt to decrease the cost of the work, we have been trying out during the past season an outdoor type, three-phase transformer.

The use of the three-phase transformer in large units for main station and substation installations has become a common practice, but the three-phase transformer in small units for distribution purposes has not come into general use. This, no doubt, is accounted for by the fact that a three-phase transformer can only be best used where a strictly power load, or other balanced three-phase load is to be supplied.

After a rather extended investigation, conjointly with the manufacturers, a transformer was decided upon, having a Y-Y winding. Certain taps were desired on the high tension side of the transformer, as well as double voltage arrangement for the secondary side of the transformer, and the Y-Y windings allow these arrangements in the simplest manner. The high tension winding is ungrounded; the neutral point of the low tension winding is grounded, as a safety measure. The usual connection of the secondary coils is for a 460 volt service, although two secondary coils are provided on each leg of the transformer, so that a 230 volt service can be obtained if desired. With a ground at the neutral point it is impossible to obtain a voltage in excess of 266 from any secondary line wire to ground. In most cases a few lights are required around the pumping plant and to furnish this service a tap is brought out from a winding on one leg of the transformer to supply 110 volts to the ground connection. Transformers of this type are being made for us in sizes from 10 to 100 kilowatt.

Shown by Fig. 2 is a typical installation of 30 kilowatt three-phase transformer. The high tension line is controlled by pole top air break switch, operated from lever at the base of the pole. On the same mounting with the switch are fuses, consisting of three-quarter inch (¾") Bakelite tubes, 12" long, in the center of which is placed the fuse wire, and the space filled with plaster of paris. With this arrangement the transformer is disconnected by the customer at times when the plant is not in operation and thus unnecessary core losses are prevented. In case it becomes necessary to replace one of the high tension

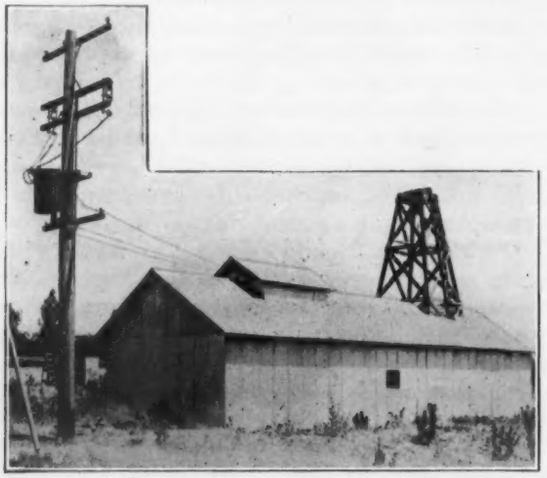


Fig. 2—A Typical Installation of 30-Kilowatt Three-Phase Transformer.

fuses, the switch is opened by the troubleman, before climbing the pole, so that he is not called upon to work on energized apparatus.

There is a saving to the company of from $25.00 to $50.00 on each installation by using the outdoor three-phase transformer, rather than installing the single-phase transformers within the building. In addition to this, there is a saving to the customer, as he does not have to furnish the extra space and foundation for the transformers within the building.

In converting an old gas engine plant to electric drive it is unnecessary for the customer to include any expense for extending his building, as would be required for an indoor installation. This extra expense might influence the consumer against displacing his engine.

Fig. 3 shows a recent outdoor installation of three 50-kw. transformers. Installations of this capacity are somewhat unusual, and we have not as yet considered the three-phase transformer in size above 100 kilowatts. The picture serves to show how much more complicated the connections, both high and low tension, become for installations of three single-phase transformers compared with the single unit three-phase transformer.

From the standpoint of general appearance, the indoor installations are more pleasing than the outdoor installations, even when simplified with the use of three-phase transformer mounted on a single pole; it is only when "safety first" is considered that the outdoor installation "looks good."

One of the features of the present methods which is not entirely satisfactory, is the use of protective high tension fuses. We have had cases where one of these fuses would blow, leaving the motor operating single-phase, resulting in the burnout of the motor or the transformer. If some reliable automatic three-pole switch could be devised, cost of which would not be prohibitive, the installation, I believe, would be much improved.

The use of steel poles on which to mount the transformer and switch has received some consideration on account of the possibility of the wooden pole

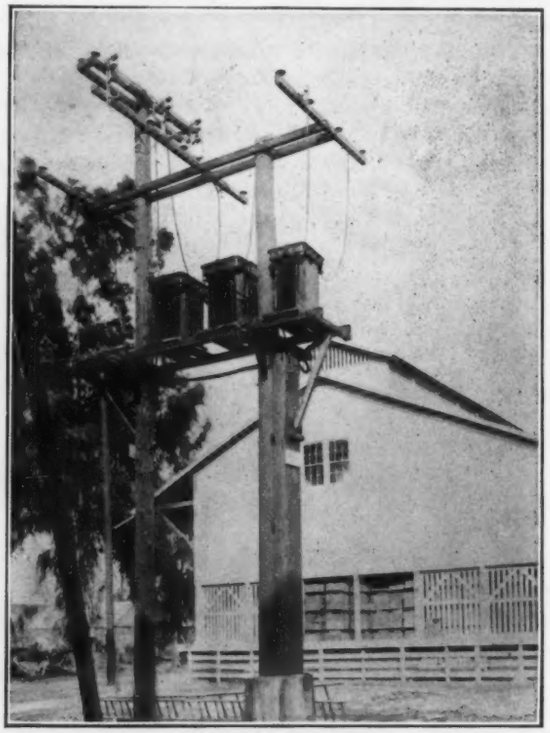


Fig. 3—Outdoor Installation of 3-50 K. W. Single-Phase Transformers.

being burnt down by brush fire or faulty insulator, but on account of extra cost we have not as yet proposed any installations of this kind. It might be advisable, however, to utilize the old tripartite steel poles which are being removed from transmission lines in case a better place is not found for them.

"Electric piano week" is to be aggressively advertised March 13-18, 1916, by a committee representing various manufacturers of electric pianos, electric motors and the Commercial Section of the National Electric Light Association.

Powdered coal is being tried in an experimental way in the smelters of British Columbia as a means of utilizing low grade coal and getting better efficiencies, the coal being finely crushed and sprayed into the furnace with compressed air, somewhat as oil is fired. This method is also being tried out in locomotives and in steamships.

REPORT ON THE COLUMBIA POWER PROJECT.

BY L. F. HARZA.

Appendix G—Problem of Flood Control.

(Concluded.)

Tainter Gate. As an alternative to the Camere dam there has been studied the feasibility of a large tainter gate closing an opening of the same size. This has been assumed as reversed from the usual direction of water pressure for a gate of this type in order to permit the load to bear downward upon the pier instead of upward and for any advantage gained by putting the principal members in tension. A general drawing of this gate is shown in Fig. 38.

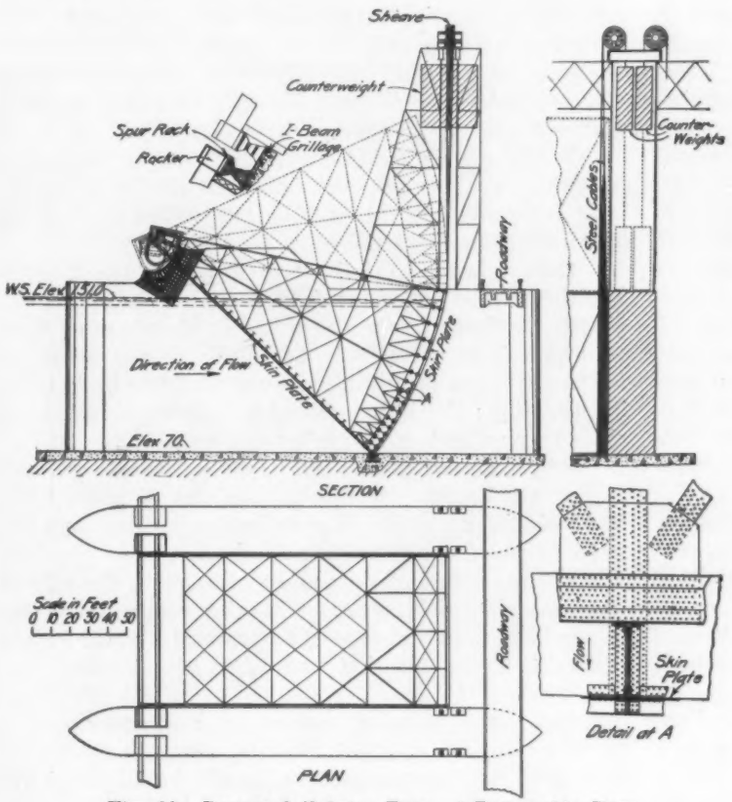


Fig. 38. Reversed Tainter Type of Removable Dam.

A skin plate would be provided along the arc of the gate as shown in the detail. To avoid putting the rivets in tension, the I-beam stiffeners would be placed in a vertical position on the downstream side of the skin plate and framed into the extended webs of horizontal girders about 4 ft. deep, spaced to suit the pressure. The entire width of the gate, 80 ft., would be divided into 4 panels by vertical diaphragm plates, into which the above girders would frame, these plates forming a part of the tension chords of vertical trusses which would transmit the reactions of all the girders to an upper, a lower, and a medial horizontal truss, these trusses (shown in plan) being in a radial plane and having their end posts extended to meet at the central axis. The axis would consist of several heavy plate girders extending at the ends beyond the limits of the gate and into the bearing on the pier.

The bearing would consist of a rocker built as a large ribbed steel casting having a convex rolling surface 10 ft. wide and curved in the form of a spiral. The axial girders would project from the gate into and through this casting. This rocker would roll on a concave surface of another steel casting also 10 ft. wide. The latter casting would be built as an inverted conical pedestal with lower flat contact surface resting upon the long radius convex surface of another conical pedestal, which in turn would rest on an I-beam grillage imbedded in the concrete of the pier. The lower pedestal would probably be built in two or more pieces, as shown, to reduce the size of a single piece.

The concave casting is thus made to tip laterally to permit its adjustment to the deflection of the cantilever ends of the axial girders and thus prevent the concentration of the load on the inner edge of the bearing. To permit this casting to tip freely it is supported at its lower end on a nest of rollers arranged radially with the arc of tipping. The concave rocking surface would be so designed as to be normal as nearly as possible at all positions, to the direction of the resultant of water pressure and dead load so that the rocker would have the minimum tendency to slide tangentially along the concave surface. Any such remaining tendency would be overcome by means of large spur racks along the outer edges of both rocker and rolling surface, designed to mesh with each other.

Both the loads between the rocker and its concave supporting surface and between the two conical pedestals would be resisted theoretically along a line. In the choice of radii for these castings the precedents established by similar pedestals in steel bridge construction were followed. The reduction in water pressure against the gate as it is raised permits the use of a decreasing radius or a spiral for the rocking surface.

The gate would be counterweighted by cables attached to the lower edge on the downstream side and running up the face of the gate and over sheaves on the top of high operating towers to a set of eveners and then to the concrete counterweights within. Grooved castings in which the cables would lie, would be provided up the face of the gate. As shown in the sketch, the plane of the cables is warped 90 degrees between the drum and the face of the gate. This would require that the cables be spaced wider at the bottom of the gate to prevent them from touching in the middle. If preferable, two sets of eveners just above the gate, and set at 90 degrees with each other, could be used to rotate the plane of the cables, and the eveners above the counterweight could then be eliminated.

The total load to be lifted would be about 2000 tons which would require at each end of the gate about 16 plow steel cables of 2¾ inch diameter and sheaves 14 ft. in diameter.

The reversal of the tainter gate from its usual position is objectionable in that many large and small steel members of the entire structure would be submerged and subjected to a large load from the dynamic pressure of a high velocity of water, if discharging with the gate only partially raised. These stresses would be very large, as learned from the studies for the Camere dam. In the winter season, ice would at times form around

the many steel members where they emerge from the water and the gate could not well be lifted without first cutting out the ice to prevent it from injuring the smaller members by breaking loose and falling, after raising the gate. The first objection has been met by providing the whole lower plane of the gate with a skin plate through which many holes would be provided to equalize the water levels while raising and lowering the gate.

In the tainter gate scheme of control only two roller dams have been provided, these to be used for drift and ice sluices on the Oregon side. This makes it necessary for the tainter gates to operate at varying openings for the close regulation of head and discharge. This would not be practicable when ice or drift were running, as the velocity of approach to the gateway would be very high; heavy drift would collide with the lower skin plate and in sucking under the partially opened gate would further endanger this skin plate and also the downstream face of the gate, should it remain in the destructive eddy which would form above the zone of discharge. It is therefore believed that the satisfactory operation of this gate is also dependent upon the successful diversion of drift and ice by a boom, although perhaps not as vitally as with the Camere dam.

The gate here proposed is of course far beyond any precedent for structures of its class. When compared with large bridges, in which the stresses cannot be as definitely computed as here, the same cannot be said. Many individual bridge members can be cited with stresses greater than in any member of this gate.

It is believed that the heaviest lift bridge span thus far built is that of the O-W. R. & N. Company bridge in Portland, Oregon, the weight of which is 1700 tons, and is lifted in much the same manner as proposed for this gate. The lifting of the greater weight here proposed does not change the nature of the problem except insofar as the cables must be concentrated into a narrow width on the gate and on the sheave above instead of being spread out by two or more sheaves as they can be along the end of a bridge span. This difficulty is not believed to be insurmountable.

The large bearing here proposed is sustained by the least precedent perhaps of any feature of the design. The elements of this problem are again however not novel in most respects to large bridge structures. The concentration of an immense load along a straight line by means of a conical webbed casting and the subsequent distribution of this load by such a pedestal to a safe working value for concrete has often been accomplished, notably in the new skewbacks of the Hellgate arch, (Engineering Record, August 22, 1914, page 216), where a load of 30,000,000 lb. was thus concentrated, about three times the load to be taken by one bearing of the proposed gate. A heavy web 8 in. thick was there provided in the pedestal immediately beneath the line of contact with three inch webs elsewhere. The fact that our line of contact must travel along the rocker, being alternately above and between the supporting webs, introduces the new problem of carrying the load as a beam between webs with sufficient strength along any line of contact to support the load. This will require a thick flange for the rolling surface and closely spaced webs.

A study has also been made of the adaptability of an ordinary roller bearing for which there would be required 29 rollers each 12 in. in diameter, rolling in a race of 20 ft. outside diameter, the outer casting being a conical pedestal similar to the concave rolling surface previously described and provided to rock in the same manner to avoid concentration of pressure at the inner ends of the rollers.

Time has not been available for a complete solution of the problems of this gate and bearing. The feasibility of the main members of the gate proper have been assumed, without attempt to design them, based upon the fact that larger members are in use elsewhere. Their weight has been estimated from their loading, and an assumed unit stress. The smaller diagonal braces and the effects of many secondary stresses have been allowed for only by rough approximations and by a contingent weight.

While not being finally committed to the entire feasibility of this gate, particularly the bearing, yet it is believed that the problems involved are not insurmountable.

Comparisons. Of the two schemes, the Camere and the tainter gates, for the removable dam here proposed, the former represents nearly the extreme limit to which it is practicable to subdivide the structure for the purpose of minimizing the loads to be handled in operation; the latter probably represents nearly as close an approach to the other extreme.

The Camere dam would be the more expensive to operate because of the multiplicity of parts to be handled, the necessity of greasing many bearings, the need of much maneuvering of the crane in the handling of the gates, girders and chains, with the attendant annoying difficulties. On the other hand that it would be much cheaper to construct should be evident, due to the fact that two-thirds of the water pressure against the dam is conveyed at once to the foundation instead of being carried by a complex system of trusses to a costly bearing, and also due to the fact that but one operating crane would be required and that to lift only 200 tons instead of individual equipment of much greater capacity. The simplicity of operation of the tainter gate nevertheless commends it strongly even at greater cost.

Neither design has been carried out to its last analysis, but the Camere type has been much more completely studied, as it was started first. In its study the complete general designs and analyses of the dams of this type on the Panama Canal were available, which greatly reduced the labor and to some extent contributed to the work the benefit of the vast amount of study which was given to this problem by the engineers of the Isthmian Canal Commission. It is also somewhat reassuring to have the benefit of the precedent thus established, in proposing a structure of this type, even though the structure here proposed is considerably greater in magnitude.

The problem of erection is much simpler, quicker and less hazardous in the case of the Camere dam. Everything except the overhead trusses could be fabricated completely in the shop and shipped ready to merely lift into place. The erection of the overhead trusses could proceed regardless of the stage of the

river, without falsework and without danger from high water, which danger would affect only the setting of the lower girder seats. The erection of the tainter gates would be accompanied by some risk. The gate seat is at 70.0, the normal elevation, for a flow of 100,000 second feet. The form of the tainter gate necessitates very elaborate and expensive falsework for its erection as well as much field riveting and calking. The erection period would be long and a gate would need to be completed with towers, cables, sheaves and counterweigths before it could be raised out of danger from possible high water, which might do great injury to both gate and falsework if only partly erected.

Conclusions. While the studies of neither type of dam have been completed, yet it is believed that they, especially the Camere, have been carried far enough to solve the main problems bearing upon the feasibility of constructing and operating dams of these sizes, as well as to furnish the basis for a reasonable estimate of cost. Should a concrete dam across the narrows ultimately be adopted, the controlled depth would decrease from 80 ft. to about 60 ft. and the structures be brought much closer to precedented sizes.

It is probable also that in the final design of the project it will be found possible to decrease considerably the controlled depth as used herein even with the use of a rock fill dam. The designs of these structures were nearly completed to their present state before the study of probable frequency of extreme floods as shown in Fig. 18 was available and in which it is shown that the flood of 1894 is probable only at very rare intervals. The flood of 1,400,000 second feet as used herein, was adopted partially as a margin of safety to allow for greater floods, which purpose could probably now be eliminated, thus increasing the head available for flood discharge from 7 ft. to 11 ft. and decreasing the depth of control to about 62 ft. The large flood was assumed partially however to allow for a possible error in the estimate of the flood of 1894, which error might easily equal or exceed 10 per cent in either direction; also to allow for possible errors in the estimate of the river elevation at gages 2 and 3, the tailwater of the flood channel; also in the headwater record of 1894, and errors resulting from lack of hydraulic data applying to the proposed flood channel. The final design should include an experimental study of the hydraulic coefficients of headworks such as proposed, and daily records of the elevation of gages 1, 2 and 3, should be kept during each high flood such as that of 1913, from now until the final design is made.

It is believed that some reduction in controlled depth is justified at this time. The records as shown in Fig. 34 indicate a drop in 1894 between gage 1 and gages 2 and 3 of about 12 ft. If this be reduced to 11 ft. to allow for possible errors in gage heights;

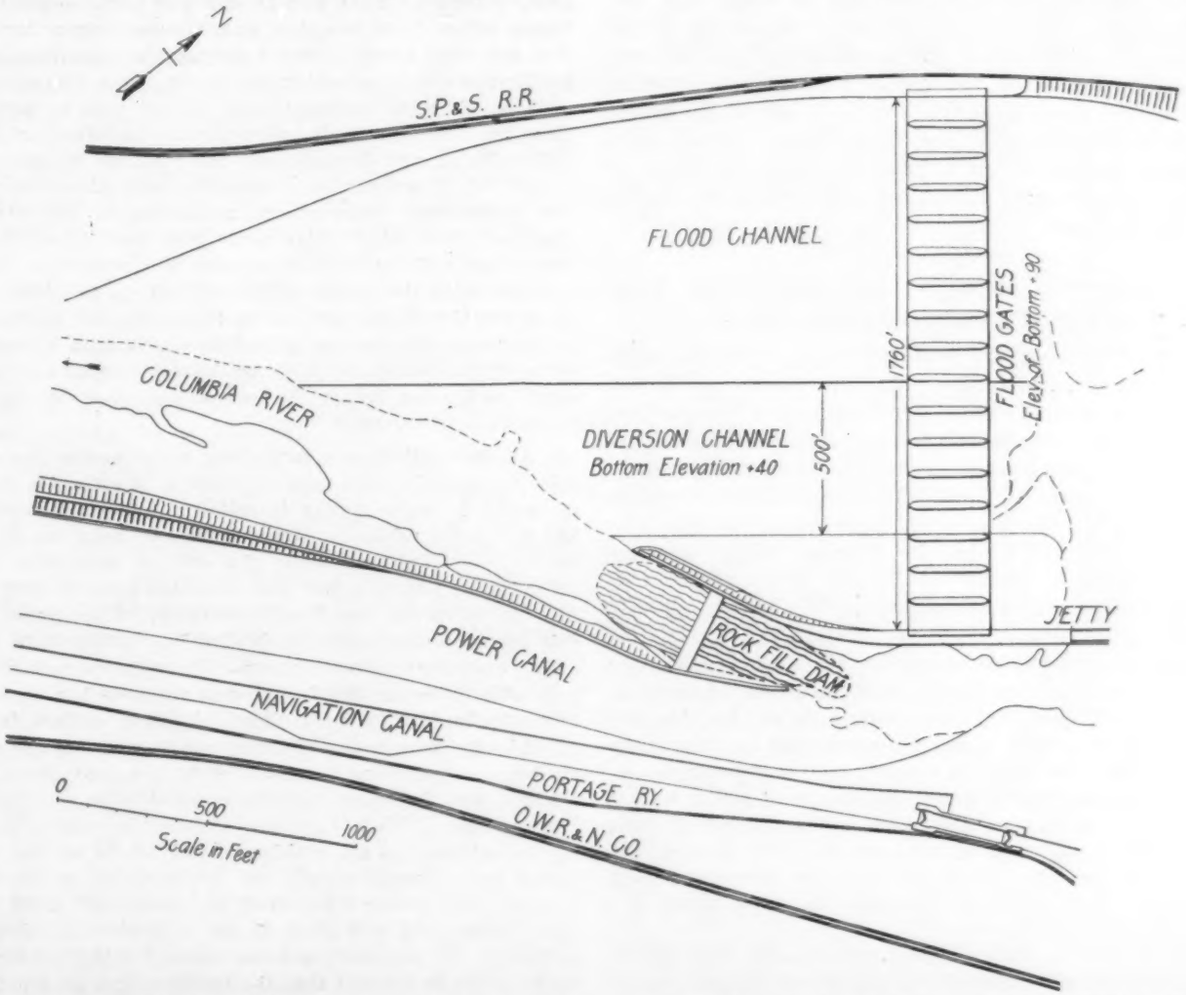


Fig. 39. Possible Alternative Arrangement of Headworks, Transferring Canal and Power House to Oregon Shore.

and if it be then assumed that the estimate of the discharge in the 1894 flood, obtained by extending the rating curve, Fig. 12, is 10 per cent too small or that the actual discharge was 1,290,000 second feet; then the bottom of the flood channel would be raised for the rock fill dam as shown in Fig. 35 from elevation 70 ft. to elevation 84 ft., and for the concrete dam with flood gates, shown in Fig. 36, from elevation 90 ft. to elevation 100 ft.

In addition to the above causes which may permit an ultimate reduction in the controlled depth, it should be said that another possible layout of the entire project, conducing to this same end, was conceived too late to be considered in detail in this report or in the estimates of cost. The headworks of this scheme are shown in Fig. 39. The dam would be built below the deep pool or about 1100 ft. below its former location. The power canal would originate on the Oregon side of this pool and could be made to clear the present navigation canal by using a concrete river wall and a narrow initial section with bottom elevation below the river bed to be excavated behind a natural rock cofferdam. The power house would then be located on the Oregon side of Big Eddy (see Fig. 9) between the lower locks of the navigation canal and the main channel of the river. There are important objections to this layout as regards the location of the power house and canal and their effect upon the flood capacity of the river. Much study, including soundings at the proposed damsite and at the lower end of the rapids, where the water enters Big Eddy, would be required to determine the feasibility of this scheme. It is offered as a suggestion for future consideration, as it would leave available for flood gates the entire bench to the right of the damsite and would thus decrease the necessary controlled depth to about 60 ft. for 1,400,000 second feet, or about 50 ft. for 1,290,000 second feet.

STIMULATING PUBLIC INTEREST IN THE WATER POWER IMPASSE.

The February 9th issue of "The Outlook" contains an excellent article on the unfortunate conditions as regards water power development. The author, Hugh L. Cooper, engineer for the Keokuk plant on the Mississippi River, presents the subject so cogently that a few extracts seem desirable. After showing the difficulties that engineers have overcome and emphasizing the need for the development of our wasting water powers, he says:

The average cost of a water power per horsepower may be taken at about five times that of steam, and in addition the difficulties in raising money and the cost of money for water powers are much greater than for steam, because the steam plant is free from flood hazards in construction and operating periods, and it can be constructed in small units about as the market requires, whereas the water power usually has to be greatly overdeveloped and then wait for its market to grow up to it, thus entailing large additional interest costs while securing and waiting for business. The water power requires for operation about one-fourth the amount of labor that steam power requires. Therefore the water power conserves labor as well as coal.

About the time that engineers had learned their lesson and were able conservatively to design and estimate water power plants, and about the time the optimists and commercial men had learned that it is necessary to sell hydroelectric power for about sixty-five per cent of the cost of steam power, along came a wail all over the United States because, it was said, a so-called water power trust was robbing the people, and then began a campaign in Government circles and in magazines that reduced the water power industry to its present state of innocuous desuetude.

Any intelligent truth-seeker who has honestly investigated the subject has found that no water power trust exists now or ever has existed, and furthermore, never can exist in the face of a steam competition which no aggregation of capital could possibly control; that no banker is seeking investment in new water projects; that practically every banker who has ever made an investment of this class for his clients will recite a hard luck story of disappointed expectations and hopes; that the market has been flooded with prospectuses and reports on projects which no substantial investment interest will take up because of the present general unpopularity of water power securities.

It is stated by some who oppose changing the present laws for development of water power on public lands that there is no necessity or demand for additional developments in the West, because some existing power companies have sufficient power unsold to supply the present and near future market. The suggestion by Government officials that great areas of territory in the West and South shall be deprived of industrial growth through water power assistance until these few restricted districts have consumed all the developed power is so unfair and unsound economically as to be almost pitiful. Our railways had to overdevelop that the country might develop, and the same is true of the water power industry. It can also be said that in the entire United States today there is not a single water power developed that can offer power terms justifying the establishment of fertilizer works, electro-chemical works, large irrigation projects or nitrogen fixation plants. It can also be said that there are now tentatively under serious consideration in the United States new developments that will call for more than $75,000,000, all waiting for encouraging legislation only. Must our unnecessary importations, amounting to $50,000,000 a year, and many other crying needs, wait until a few Western plants can sell out a small amount of power now unsold? I do not think the people will take kindly to this idea. Furthermore, if it should turn out in the future that more power is developed than can be immediately sold, such a condition is hardly one which the public or the Government need worry about, so long as the people reserve to themselves the right to regulate power rates.

Another little-known fact about water power that bears upon the question with peculiar force at this time is the one of profit in water power investments. Steam competition has driven the prices for power lower and lower for the past twenty-five years, and while the cost of practically every other human necessity has been mounting upwards each year, the cost of power has been steadily going downward, and this process was strongly established long before state public utility commissions were created. For water powers to compete with these steadily declining steam costs has been very difficult. In 1912 over five thousand power stations investigated by the Department of Commerce showed that the steam stations were earning a surplus of 4.1 per cent above fixed charges, and the water power companies were earning only 1.78 per cent. This 1.78 per cent showing is a fine tribute to the financial genius and grabbing results of the alleged water power trust. Investors will not be attracted to securities afflicted with strong competition and many and great risks, legal, commercial and physical, for a surplus anything like as low as 1.78 per cent; and the reason for their attitude is easily found in the fact that the investors can go into many other safer fields and make much more.

THE DIESEL ENGINE IN PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Diesel Applied to Marine Purposes.

The beginning of the application of Diesel engines for mercantile ships was made in Russia on the river Volga and the Caspian Sea. They were designed for ships owned by the firm of Nobel Bros. in Petrograd and were partly built in their own shops and partly at the Kolonna Works in Moscow and at the Swedish Diesel Engine Company in Stockholm.

These new marine engines were first built in Russia for two reasons: First, because there are large oil wells at the Caspian Sea, whereas other fuels are expensive in that vicinity. This brought, therefore, the first stationary engines from the Maschinenfabrik Augsburg-Nurnberg at an early time to these countries. But, that cheap oil and expensive coal does not necessarily lead to the early adoption of marine Diesel engines is demonstrated on the Pacific Coast of the United States in regard to stationary engines, where circumstances are similar in this respect.

The second factor was the progressiveness of Nobel Bros., who, being owners of oil fields, as well as of ships and engine works, had everything in their possession necessary for the realization of their plans in this line.

In this way there existed in Russia several marine Diesel engines long before the rest of the world earnestly considered the manufacture of such engines. The construction, however, was mainly the same as of the standard stationary engines of the Nurnberg type with slight changes. But, when observing the present day big Diesel engines for sea-going ships, it is noticed that the valves and valve gear are copied from the original stationary engines; otherwise they are different in many ways. After the engines of Nobel Bros. a few small marine Diesel engines were turned out in 1910 by Sulzer Bros. of Winterthur, and the Machinenfabrik Augsburg-Nurnberg, known in their country as the Nurnberg Company. These engines were high-speed, box frame engines of comparatively low power. They did not yield much satisfaction in continued service, being much of the type of light weight submarine engines.

Up to 1910 all marine Diesel engines were designed with the long trunk piston in which the wrist pin was fixed, to which the connecting rod was fastened. In 1910 for the first time, a box-shaped piston with piston rod, cross-head and guide was introduced in place of trunk pistons and are now used in almost all types of marine Diesel engines. At this time there was also applied the four tie-rods around each cylinder coupling most directly the upward forces due to the pressure on the cylinder heads and the downward forces on the main bearings due to the pressure on the pistons. By these means it became possible to keep the cast iron frame in which the connecting rods move, very light and to provide for big apertures, as this box-shaped frame had to carry the weight of the cylinder only, no forces being transmitted through it.

After the small Diesel marine engines, the six-cylinder engine of the "Vulcanus" was the first full-powered reversible Diesel engine, shown in section in Fig. 28. This engine had a capacity of 450 b.h.p. at 180 r.p.m. The cylinder was 15.7 in. in diameter and 31.5 in. stroke. The ship is of 1000 tons, owned in Holland. The hull and engine was built in Amsterdam; it was ordered in 1910 and in December of the same year the trial trip took place.

In the beginning trouble was encountered with the air compressors and also through the lack of experience of the engine attendants. The ship has, however, completed successfully every voyage undertaken, among others a trip from France to Singapore without an extra stoppage at sea, and it is in permanent service in India at present, to the full satisfaction of the owners.

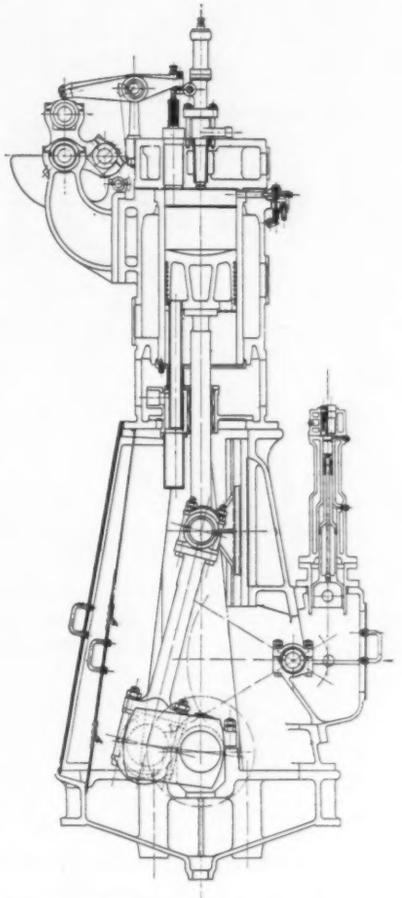


Fig. 28. Six-Cylinder Werkspoor Marine Diesel Engine of the "Vulcanus," 450 b.h.p.

The engine of the "Vulcanus" is directly reversible, there being two cam-shafts, one with cams set for forward motion, the other for backward motion. The hand-wheel for the reversing is mounted on a handle case, where all the operations necessary for starting, reversing, regulating and stopping can be controlled. The valves and levers in the cylinder heads do not differ from what is ordinary practice for four-stroke-cycle stationary Diesel engines.

The fuel pump shows an interesting feature. There is only one pump and one spare pump for the whole engine. The oil is pumped into an accumulator, which stops the pump when full by keeping the suction valve open. The "Vulcanus" is now plying between the East Indian Islands, making short trips.

There is inserted here a comparison made by the marine superintendent of the Anglo Saxon Petroleum

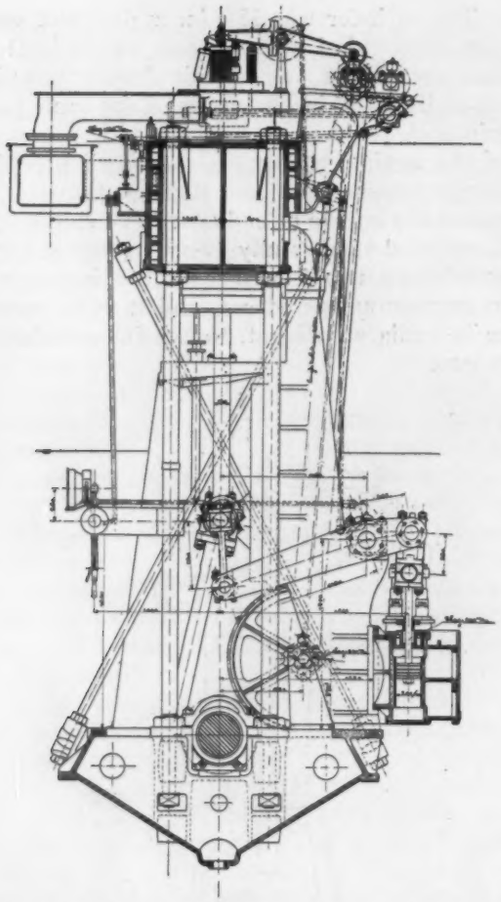


Fig. 29. Werkspoor Marine Diesel Engine, 1100 b.h.p.

Company, the following comparison showing the result of two years' actual working with the Diesel Ship "Vulcanus" and the S. S. "Sabine Rickmers" using coal:

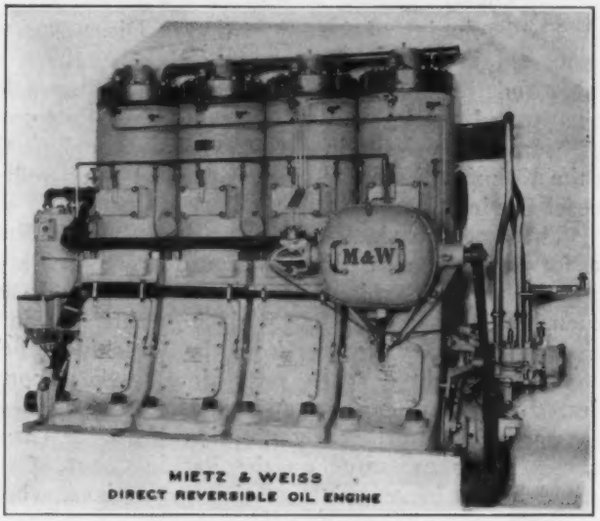
	"Vulcanus"	S. S. "Sabine Rickmers"
Length	196 ft. 0 in.	200 ft. 0 in.
Breadth	37 ft. 9 in.	30 ft. 6 in.
Draught	12 ft. 4½ in.	16 ft. 9 in.
Deadweight—		
Carrying capacity	1235 tons	1269 tons
Displacement	2080 tons	2290 tons
Engines	6 cylinder reversible	Triple expansion

The following economic results have been shown in service:

	"Vulcanus."	S. S. "Sabine Rickmers."
Total running time on voyage	8.26 days	7.04 days
Total distance	1530 miles	1473 miles
Mean speed	7.7 knots	8.7 knots
Average oil consumption per day of 24 hr.	2.06 tons	13.4 tons
Cargo	976 tons	1013 tons
Dead weight	1112 tons	1225 tons

A striking example of the advantages associated with low fuel consumption is to be found in the fact that the "Vulcanus" recently completed a voyage of eighty-eight days without bunkering at any intermediate port. On this particular run she left Europe in August with 140 tons of fuel oil in her bunkers and returned in November, covering a distance of some 10,750 miles. Nevertheless, six tons of liquid fuel remained on board after the completion of the voyage. Thus the total consumption was 134 tons in 65.7 operating days or 2.03 tons per diem.

The "Vulcanus" held for the full year the place of being the only full-powered Diesel ship afloat, from the end of 1910 to 1911, when the "Sembilan" was constructed. This vessel had a comparatively small engine of 200 h.p. in three cylinders, the engine being



Typical American Marine Engine.

reversible. This vessel proved very successful and is at present running to the East Indies, the owners having since ordered five engines for larger vessels.

(To be continued.)

LETTERS TO THE EDITOR.

Importance of Plain Writing.

To the Editor—

Sir: I have just now read the editorial on the "Importance of Plain Writing" in the February 12th issue of the Journal. I have done this with much interest and profit to myself. We realize the responsibilities of the engineering colleges with regard to English for engineers. An editorial such as this one constitutes an important moral backing for us in our efforts to meet these responsibilities with improved results of the sort you indicate so clearly to be highly desired.

Cordially yours,

HARRIS, J. RYAN,

Professor of Electrical Engineering.

Stanford University, Feb. 11, 1916.

To the Editor—

Sir: I want to congratulate you on the editorials in February 5th issue of the Journal on the "Decline of Water Power Development," and also on "What is an Engineer?" I think you will find that the teaching faculties of the various colleges are more keenly aware of the truth of this analysis than your editorial would give us credit for, and the thing that prevents the immediate adoption of these principles in our engineering education is the fact that unfortunately we are forced to give education in some degree that the public who pays the bills thinks it ought to have. So then it is a question with us of educating the public into accepting what it ought to have.

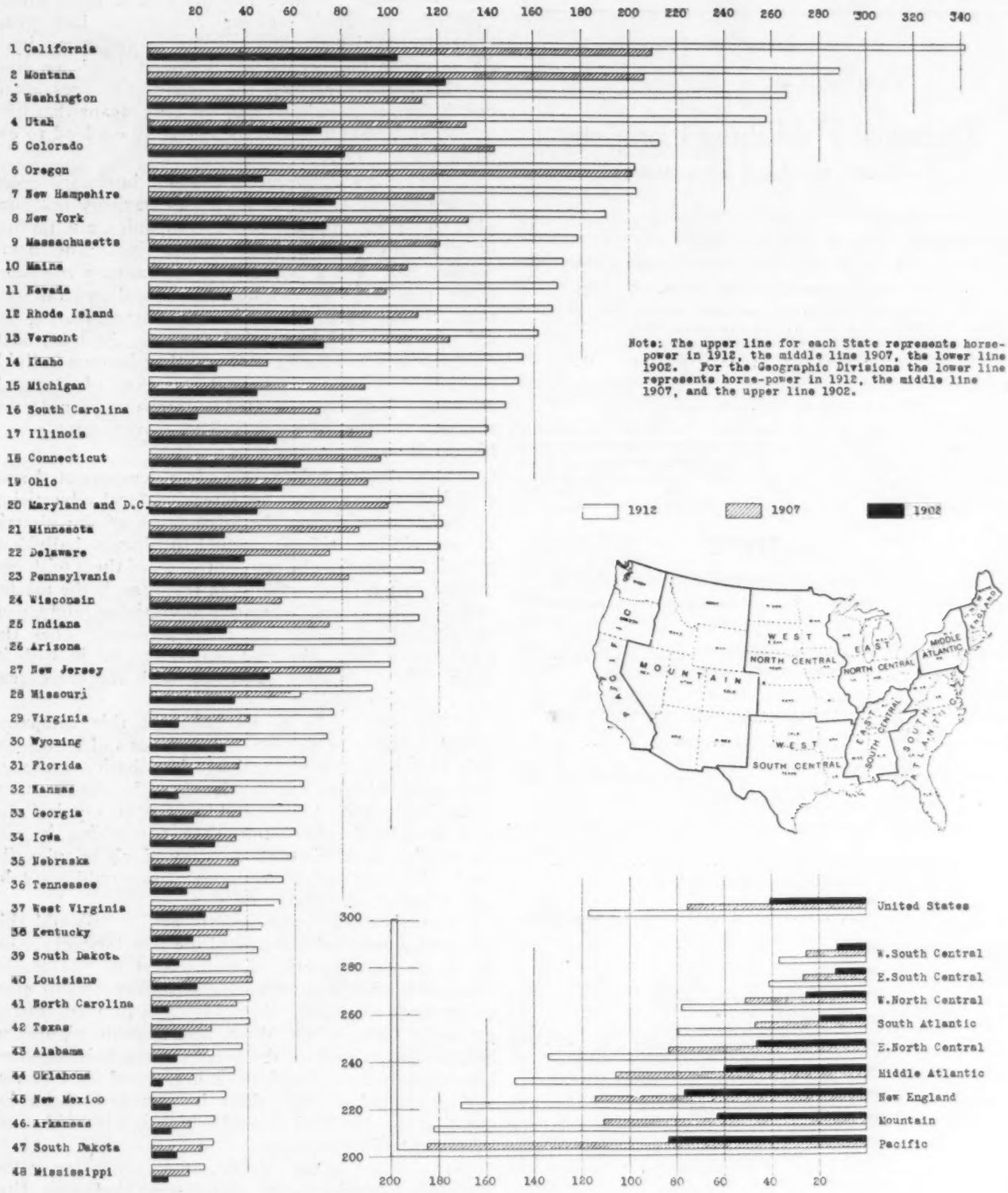
Very truly,

W. D. PEASLEE,

Department of Electrical Engineering, Oregon Agricultural College.

Corvallis, Ore., Feb. 7, 1916.

PRIMARY POWER USED IN U. S. PER THOUSAND OF POPULATION.



To accompany report on Sen. Res. No. 544, 63rd. Cong., 3rd. Sess.

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Increasing the Range of the Electric Range

Ten thousand electric ranges can be sold in the West during 1916. One central station has put two hundred new ranges on its lines during the past six weeks, another has put on three hundred within three months and a third added over six hundred cooking consumers last year. Other companies are just starting similar campaigns. At rates of four cents per kilowatt hour, or less, for this class of service, the revenue averages about one dollar per month per person. This means that fifty thousand dollars a month income can be added to existing power lines.

The efforts to interest consumers in electric cooking are mostly being carried on in territory not supplied with gas, though some companies are finding little difficulty from such competition. The usual method has been a house-to-house canvass co-operatively conducted by manufacturers and central stations, though some companies are wisely enlisting the aid of electrical jobbers and dealers. At best, such methods are necessarily slow, as they involve individual introduction and personal creation of demand, whereas a judicious advertising campaign would pave the way for the salesman and effectively supplement his work.

Now that electric cooking is a demonstrated success it is time to start an intensive local advertising campaign proclaiming the advantages of the electric range. No one will run around turning on individual electric lamps when he can control all of them with one master switch. Advertising, in this case, is the master switch. The general educative advertising might well be initiated by the several manufacturers. Then the local power companies and dealers can tie in with it, linking their intensive sales talk with the more general extensive publicity.

The best mediums to carry on this campaign would probably be the country weeklies and farm journals, as the small towns and farming districts are most frequently without gas service and the people more easily interested. This would be more economical and less wasteful in circulation than advertising in mediums of national circulation, many of whose subscribers in the East and in the large cities would not take advantage of this opportunity.

Here is need for immediate action. Should this suggestion meet with approval the new business managers of every power company west of the Rocky Mountains should write to the manufacturers of electric ranges requesting that this campaign be started at once. Here in the West where from eighty to ninety-five per cent of the houses along existing lines have already been wired, there is no need for a house-wiring campaign. But there is urgent need for increasing the day load, a need which is admirably met by the electric range.

The report of the electric range committee of the National Electric Light Association indicates that this is a most desirable load for Western companies. The report represents the serious effort of broad-minded, thinking men. Their recommendations are worthy of careful consideration and some campaign should be started to cash in on the opportunity that is here presented.

Electrifying Western Chemical Industry

The electrochemical industry has long been a vague possibility as a consumer of hydroelectric energy on the Pacific Coast. Recent changes in sources of chemical supply have converted many of these latent possibilities into active probabilities. Consequently a peculiar present value attaches itself to the expert estimates made by J. W. Beckman elsewhere in this issue.

His analysis shows that its abundant raw materials give the Pacific Coast an advantage over other electrochemical centers. Great quantities of limestone are cheaply available for the manufacture of calcium cyanamide and calcium carbide and the smelting of ores. Large deposits of iron, copper and zinc ores are found in many localities.

The tremendous production of California fuel oil supplies hydrogen and carbon as reducing agents. This carbon, in the form of briquetted lamp black, now almost a waste by-product in the manufacture of gas, is in many respects superior to the charcoal which has made Swedish iron famous. The Pacific Coast likewise has more standing timber adapted to charcoal manufacture than Norway and Sweden. The elements used in the manufacture of alloy steel, tungsten, chromium, manganese and silicon are all mined on the Coast and shipped East.

Mr. Beckman likewise shows that electric power can be generated as cheaply in the West as anywhere. Labor is but slightly higher and to some extent can be replaced by mechanical power. Furthermore, one unfortunate effect of the European conflict has been to deplete the number of able-bodied workers, so that European and Eastern labor costs will undoubtedly tend to approach those found in the West.

All these facts point to the likelihood of a greatly increased electrochemical activity on the Pacific Coast within the next few years. Powder manufacturers, who have a number of large plants in California, are already installing equipment to harvest and treat kelp, the latest plant being that of the Hercules Powder Company at San Diego. Large scale experiments are being made on air-nitrate production, with good promise of bettering the low efficiencies found in European plants.

The greatest permanent opportunity, however, seems to lie in the manufacture of fertilizer to supply the three essentials of plant growth, nitrogen, potassium and phosphates. Nitrogen constitutes four-fifths of the air we breathe; potassium makes up one-fifth, by weight, of the giant kelp beds which cover an area of about four hundred square miles along the coast of Washington, Oregon and California, and also is found in several natural salt deposits, and rock phosphates are abundant in Idaho. There is a heavy demand and good prices for mixed fertilizers, so that every inducement is offered to embark on their manufacture.

Electric smelting of iron ore is also an attractive proposition, though the initiative in the matter will probably come from the steel trust, which controls most of the extensive deposits of iron ore in California. A variety of causes which contributed to the failure of the Noble Electric Steel Company at Heroult, California, could be avoided in future work in this direction. The possibilities of progress are indicated by the fact that the total amount of pig iron from electric furnaces throughout the world is but little in excess of that produced by one modern blast furnace. Electric steel furnaces are now an assured commercial success, and a number will be installed in Pacific Coast foundries this year.

Electric copper smelting, like electric zinc smelting, is commercially feasible, though still in the experimental stage. Experimental smelting of the copper ores of Shasta County, California bids fair to solve some of the metallurgical difficulties of the past. Electric zinc smelting is being tried out in a small way also in the Northwest, the great difficulty being the condensation of a blue powder instead of a metal, due to the high speed of smelting.

Several investigators agree that aluminum manufacture is not likely to flourish in this locality for some years to come. Bauxite, the basis of the present process, is not known to exist in the West, and processes for the extraction of alumina from Utah alunite are still in the laboratory stage. Some chemist in the future will solve the problem of unlocking the tremendous stores of aluminum and potassium which occur in feldspar, but this is still a dream, as far as demonstrated practical results are concerned. Aluminum is the most abundant metal in the earth's crust and one of the most difficult to separate from its compounds.

The processes thus far suggested employ the high heat of the electric arc as the chief means of bringing about new chemical combinations or separations. While these methods are more spectacular, they have not been applied as much in the West as the electrolytic methods employing direct current. Electrotypers, electroplaters and metal refiners consume considerable current, and recently a large company has been incorporated to manufacture caustic soda and bleaching powder in a plant to be erected at Pittsburg, California. Bleaching powder is also manufactured extensively at Oakland, California, by the electrolytic process. Electrolytic production of zinc is also a recent development, a plant now being installed in Montana.

The fly in the ointment as regards the immediate materialization of these possibilities is the hesitancy of capitalists to invest in hydroelectric developments, and the difficulty in getting permits for the utilization of these natural resources, upon which the industrial prosperity of the West is so dependent. Investors fear to tie up their money in such pioneer projects as are now subject to prohibitive legislative restrictions. Oil lands and phosphate deposits have been withdrawn from entry, "conserved" kelp is rotting on our shores and "conserved" water power is running idly to the sea.

This wicked waste shackles the West. Think of the farmer dependent upon Norwegian nitrates, the miner upon Swedish iron and everyone upon Eastern manufactured products when the requisite power and materials await only the application of human intelligence. What the West needs is not merely an electrochemical atmosphere, but an electrostatic thunder storm to awaken it to the value of its birthright—surrendered for a mess of pottage.

PERSONALS

Leonard Cairns, assistant manager of the street railway and lighting company at Manila, is at San Francisco.

E. M. Cutting, Pacific Coast manager Edison Storage Battery Company, is in Southern California.

Geo. Bower has been appointed assistant sales manager of the Northwestern Electric Company, Portland, Oregon.

H. H. Courtright, otherwise known as "Kelley," is now manager of the Valley Electrical Supply Company at Fresno, Cal.

Geo. J. Henry, hydraulic mechanical engineer of San Francisco, just returned from an extended business trip to Alaska.

S. E. Ross, commercial agent of the Trucker River General Electric Company, of Reno, spent the first part of the week at San Francisco.

H. A. Lemmon, contracting agent of the Truckee River General Electric Company, of Reno, was a recent business visitor at San Francisco.

C. R. Hunt, Pacific Coast representative of the Robbins & Myers Company, has returned from an extended trip of about a month throughout Arizona and the southern part of California.

J. B. Lukes, formerly manager of the San Francisco office of the Stone & Webster Construction Company, has recently been transferred to the company's main office in New York.

Chas. A. Terry, vice-president of the Westinghouse Electric & Manufacturing Company of New York, N. Y., in company with wife and daughter, are recent arrivals on the Pacific Coast.

Harry L. Strange has been granted leave of absence as manager of the Honolulu Gas Company to enlist with the allies. **Frank Cannon,** manager of the commercial department, has been appointed acting manager.

W. H. P. Hill will leave shortly for California to assume a new position with the Fleishhacker interests. Mr. Hill has been with the Northwestern Electric Company in Portland for the past year as commercial manager.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, is in the East attending a meeting of the public policy committee of the National Electric Light Association.

Ewen Cameron has relinquished his connection as secretary-manager of the Electric Agencies Company, at San Francisco, and has been succeeded by **B. A. Wagner,** formerly manager of the Los Angeles office of the company.

N. Kishi, superintendent mechanical engineer of the Osaka Electric Light Company of Osaka, Japan, is a recent arrival at San Francisco, from where he expects to start on a tour of inspection of the power plants of the United States.

R. H. Ballard, secretary and assistant general manager of the Southern California Edison Company and vice-president of the National Electric Light Association, is expected to return to Los Angeles on March 4th from a meeting of the executive committee of the association.

J. R. Wilson has resigned as sales manager and second vice-president of the Crocker-Wheeler Company, Ampere, N. J., to take up activities in other fields. Mr. Wilson has been asociated with the Crocker-Wheeler Company for sixteen years, being placed in charge of sales operations in 1910.

MEETING NOTICES.

Electrical Supply Jobbers' Associations.

The next convention and annual meeting of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Del Monte, March 2, 3, 4, 1916, the first session being held on Thursday afternoon, March 2d, at 2:30 p. m.

San Francisco A. I. E. E. Section.

A meeting will be held at 8 p. m. February 25th at Engineers' Club, 61 Post street. S. J. Lisberger will speak on some features in connection with the installation of two submarine power cables across the Golden Gate.

Electrical Development and Jovian League.

At the weekly luncheon on February 16th, H. V. Carter, President of the Pacific States Electric Company, introduced Dr. Beason who gave a first-hand account of his experiences as a Red Cross surgeon in Serbia. His vivid account visualized the horrors of war in this stricken country.

Portland Sections A. I. E. E. and N. E. L. A.

At the bi-weekly lunch on February 17th, W. H. P. Hill, commercial manager Northwestern Electric Company, acted as chairman of the day, first reading two telegrams of congratulations sent to Thomas Edison on his birthday. Col. C. E. S. Wood spoke on "Preparedness," discouraging too much fighting in a "trade" war, urging that disputes be settled by arguments rather than wars. Eighty-five members were in attendance.

Inland Waterways Association of California.

The annual meeting of the Inland Waterways Association of California and a special congress under the auspices of the association, was held at the Palace Hotel, San Francisco, February 21-22, 1916. The general topic for discussion was "What Reorganization of Federal and State Agencies is Needed to Promote Economy and Efficiency in Working for the Conservation, Control and Utilization of Waters?" Papers were read Monday on "Uses of Streams," by Prof. Stephen Ivan Miller, Jr., Stanford University; "Governmental Agencies Dealing with Various Phases of Our Water Problems," Federal Agencies, J. B. Lippincott, Los Angeles; State Agencies, D. L. Beard, San Francisco; "The Department Plan in Public Work," C. E. Grunsky, San Francisco, and a general discusson, with a view to Determining to what Extent Economy and Efficiency may be Promoted by Consolidating or Co-ordinating the Work of Present State Boards, Commissions and Bureaus Dealing with Water Problems.

Idaho Society of Engineers.

The seventh annual convention of the Idaho Society of Engineers was held at Burley, Idaho, February 21-23, 1916, President Barry Dibble presiding. Reports were received from the committees on irrigation and papers presented on "The Irrigation and Code Commission," by V. E. Anderson; "The Camera and the Engineer," by F. A. Wilkie; "The Use of Concrete," by W. F. Long; "Phosphate Deposits in Southern Idaho," by Robert N. Bell; "Manufacture of Beet Sugar," by J. F. Ellis; "Irrigation Pumping and Power Rates Therefor," by W. T. Wallace; "Hydrometric Data and Practice on the Minidoka Project," by J. S. Longwell; "Silting of Canals and the Minidoka Drainage System," by F. N. Cronholm; "Surveys of Overflowed Lands in Arkansas," by A. N. Kimmell. A banquet was held on the evening of February 22nd, G. Clyde Baldwin being the toastmaster, the following responses being made: "George Washington," by J. J. Rae; "The Engineer's Opportunity to Serve His Country," by Barry Dibble; "The Success of Iirrigation Projects," by E. B. Darlington; "Just for Fun," by J. C. Porterfield; "When Times Come Good in Idaho," by W. H. Gibson; "Au Revoir," by C. H. Mull.

JOVIAN REJUVENATION AT LOS ANGELES.

A remarkably well-organized and highly successful rejuvenation of the Jovian Order was held in the Elks' Club at Los Angeles on February 19th. Tribune Henry F. Holland, early in the year, had appointed two teams, the reds and the blues, who worked up a class of thirty-nine men for initiation into the mysteries of Jovianism. The competition thus engendered was maintained at the fine banquet which preceded the rejuvenation by the appointment of two toastmasters, A. E. Morphy heading the blues and B. B. McLean the reds. It is no more than fair to state that while the blues were not as active as the reds in getting new members, they provided more pep in the way of speakers. Their representatives seemed to be talkers, rather than doers.

As chairman of the entertainment committee Harry Sessions had provided an excellent program which started the party off in fine shape. This was greatly enjoyed.

Toastmaster McLean introduced Statesman J. N. Colkitt, Paul House and Harry Sessions, as speakers for the offense, while Toastmaster Morphy produced J. E. McDonald, Past Vulcan A. H. Halloran, and E. M. Cutting for the defense.

Upon adjournment to the lodge room the ritual was unusually well presented by the degree team, as follows:

Jupiter, J. Harry Pieper.	Avrenim, C. E. Cayot.
Neptune, W. J. Gracey.	Mercury, J. O. Case.
Mars, A. L. Spring.	Imps:
Vulcan, H. F. Holland.	E. B. Clay.
Apollo, R. R. Thomas.	R. C. Starr.
Hercules, L. E. Darrow.	W. J. Barman.
Pluto, Z. H. Sherart.	H. C. McCutchan.

Including the candidates, 175 electrical men were present. The following candidates were completely rejuvenated:

H. P. Hubbard, Forue-Pettebone Co.
R. L. Smith, Pacific Light & Power Corp.
H. H. Miller, Pacific Light & Power Corp.
L. K. Thompson, Pacific Light & Power Corp.
P. D. House, Electrical Products Corp.
Edgar Ruggles, Pacific Light & Power Corp.
B. A. Griswold, Jr., Pacific Light & Power Corp.
N. H. Cox, Manufacturers' Agent, Santa Ana, Cal.
Richard Walfsberg, Electric Agencies Co.
A. B. Nauert, United States Steel Products Corp.
F. R. Palmer, Pacific Light & Power Corp.
W. C. McWhinney, Pacific Light & Power Co.
R. C. Shipman, Pacific Light & Power Corp.
W. D. Shaw, Pacific Light & Power Corp.
Schuyler Coffin, Pacific Light & Power Corp.
Frank Palmer, Pacific Light & Power Corp.
C. C. Stillman, Pacific Light & Power Corp.
E. P. Miller, Pacific Light & Power Corp.
W. E. Hogle, Pacific Light & Power Corp.
E. F. Vittum, Pacific Light & Power Corp.
S. W. Clement, self, Inglewood, Cal.
Frank Weiss, Los Angeles, Gas & Electric Corp.
A. S. Price, Pacific Light & Power Corp.
C. E. Listenwalter, Listenwalter & Gough, Inc.
A. E. Rimpan, Edison Lamp Works of General Electric Co.
Theo. Palmer, Palmer Motor Shop, Santa Ana.
P. S. Gough, Listenwalter & Gough Co., Inc.
C. R. Atkinson, Pacific Light & Power Corp.
Philip Forue, Forue-Pettebone Co.
C. H. Deaves, Western Auto Electric Corp.
A. E. Peat, San Joaquin Light & Power Corp.
C. S. Older, Pacific Light & Power Co.
J. S. Addis, Illinois Electric Co.
A. G. Hall, Illinois Electric Co.
H. A. Landwehr, American Cement Products Co.
H. A. Koll, A. Hamburger & Sons.
A. E. Ravenscroft, Baker-Joslyn Co.
T. A. Gould, Redondo Home Tel. Co., Redondo Beach, Cal.
E. L. Nightingale, General Electric Co.

NEWS OF CALIFORNIA PUBLIC SERVICE COMMISSION.

Constructive criticism of the methods used by the commission's engineers in calculating depreciation of public utilities may be invited at a series of public sessions. The straight line basis of accrued depreciation apparently works a hardship on the stockholders, and the necessity has arisen for a general discussion on the subject.

The Pacific Light & Power Corporation has filed a complaint against the City of Pasadena, requesting the commission to direct Pasadena to obtain a certificate as a public utility to furnish electricity for light and power in South Pasadena, which is separately incorporated, and to file a schedule of rates to be collected from consumers in South Pasadena. The Pacific Company also sells electricity in South Pasadena, and the company asserts that the City of Pasadena is engaged in active competition with it, and has taken away many of its customers. It claims to be losing more than $3500 a year by this competition.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

The commission has denied the application of J. A. Jones for a certificate of public convenience and necessity to construct a gas plant at Idaho Falls, Idaho, and has granted one to Wm. D. Wilcox upon condition that he commence construction not later than June 1, 1916, and have plant ready for operation by October 1, 1917.

TRADE NOTES.

The Portland council has awarded a contract for furnishing 8000 ft. of electric light cable for the proposed lighting system in Holladay Park to the Standard Underground Cable Company.

The Electric Storage Battery Company recently gave a course of instruction on storage battery design and operation to officers and men of the U. S. submarine flotilla. The Navy Department has expressed its gratification for the service.

School Clerk R. H. Thomas will receive proposals until 4 p. m. Thursday, March 2, for a program clock system for the Franklin high school, Portland, Ore. Specifications from office of School Architect F. A. Naramore on deposit of $1.

A contract for heating and ventilating Wheeler hall at the University of California, Berkeley, has been awarded to The Turner Company, San Francisco, for $51,880. The contract for electric wiring has been awarded to NePage-McKenny Company, Hearst building, San Francisco, for $6089.

The A. Lietz Company, manufacturers of surveying, engineering, mining and nautical instruments, have opened up fine display and sales offices at 61 Post street, San Francisco. As this is on the ground floor in the Mechanics' Institute Building, wherein the Engineers' Club is now housed, the location is most convenient.

CONSTRUCTION STARTED ON WISE AND HALSEY PLANTS.

The Pacific Gas & Electric Company expects to have Nos. 4 and 5 of its Lake Spaulding development, known as the Halsey and Wise plants, completed and in operation by November 1, 1916. Both these plants will utilize the discharge from the Drum plant, being carried in the Bear Valley Canal from a point just above Colfax. The Halsey Development will have a forebay, or regulating reservoir, built in the saddle of the ridge by means of two earth dams. Two pressure tunnels are designed in the alignment of the development to carry the flow of water to the power house, one of which leads directly from the forebay. These tunnels will be concrete lined, connected with a wood stave pine 96 inches in diameter and terminating with a 72-inch steel pipe line at the power house. The steel work on the power house has just been completed. The electric generator to be installed in the power house, located about three miles west of Clipper Gap, will be driven by two overhung Francis type turbines, operating as a unit to develop 18,000 horsepower under a 342 ft. maximum head of water.

The Wise Development takes the water almost at the floor of the Halsey plant from a small regulating reservoir of 120 acre ft. capacity through canals, tunnels, forebays and penstocks to the power plant in Auburn Ravine, about a mile below the city of Auburn. The generator at this power house will be similar to the one installed at the Halsey plant, having a capacity of 16,600 horsepower, and will be driven by a 20,000 horsepower Francis turbine.

NEWS NOTES

INCORPORATIONS.

ZILLAH, WASH.—Articles of incorporation of the Valley Telephone Company, with $50,000 capital stock, have been filed by L. E. Harrington, E. F. Keys, H. M. Manuel, R. W. Manuel and A. M. Murfin.

ILLUMINATION.

RIVERBANK, CAL.—L. H. Collett has a petition ready to present to the Supervisors for the formation of a lighting district for west Riverbank.

LOVINGTON, N. M.—This place will be electric lighted within a few weeks, final arrangements for lighting having been made by T. H. Beckwith.

STARBUCK, WASH.—The dam of the Starbuck Electric Company was seriously damaged by a recent storm, leaving the town without lights.

ABERDEEN, IDAHO.—The city is to have electric lights, a 50 year franchise having been granted to the Idaho Water Power Company for the installation of the system.

EPHRATA, WASH.—C. A. Logg of Bright has leased the Lee Toliver garage and has announced his intention to equip the electric light plant to furnish electricity to all who desire it.

FLORENCE, ARIZ.—An election will be held on March 11th to vote on the question of issuing bonds in the sum of $50,000 for the purpose of constructing a system of waterworks and electric lighting.

SALT LAKE, UTAH.—Extensions and betterments to the plant and mains of the Utah Gas Company to cost about $125,000 have been announced by Byron T. Gifford, chief engineer of the American Public Utilities.

SAN BERNARDINO, CAL.—At a meeting of the street lighting committee, action giving bid for lighting E and Fourth streets to J. J. Hanford was rescinded and the contract was awarded to E. J. Field for $1 a front foot.

EL CENTRO, CAL.—W. F. Holt has announced that he has sold a $25,000 interest in the Imperial Valley Gas Company to J. M. Ott of Rochester, Ind. Mr. Ott will be elected president and the main office will be moved here from Redlands.

SPOKANE, WASH.—Riverside avenue will be lighted from Division street to Cedar street if plans launched by property owners materialize. A petition has been put in circulation asking for the completion of the lighting of the avenue.

HOLBROOK, ARIZ.—The board of supervisors of Navajo county will hold a hearing on March 6th on the application of Jas. J. Shumway for a franchise for the construction and operation of an electric light and power plant in Snowflake to supply the towns of Snowflake, Taylor and Shumway.

LOS ANGELES, CAL.—The board of public service commissioners has let the contract for 4000 cedar poles to be used in connection with the installation of a municipal lighting system to Baxter & Jordan. M. S. Bulkley has been awarded the contract for four auto trucks to be used for hauling on the lighting system's work.

BAKER, ORE.—Superintendent Ross of the municipal electric light plant, has announced that the greatest difficulty with the water wheel at the electric plant had been remedied and that with the full flow of water, practically the entire estimated power could be developed. To date the plant has developed hardly more than 50 per cent of the estimated power. With this report the commissioners announced that plans would be made at once for installing cluster lights in the business district of the city and that until this could be accomplished additional street lights will be installed temporarily.

TRANSMISSION.

PORTERVILLE, CAL.—A new $40,000 substation is to be erected here by the Mt. Whitney Power & Electric Company.

BAKERSFIELD, CAL.—The board of supervisors has awarded the Pacific Light & Power Co. a franchise for the purpose of supplying the Kernville District.

LOS ANGELES, CAL.—A resolution has been adopted by the city council authorizing the city attorney to file a condemnation suit for the purpose of acquiring a right-of-way for constructing and operating electric power lines extending from a point in the county of Inyo through lands in the Providencia and Scott Tract, McOlay Ranch, and a portion of the Porter Land and Water Company, all lying in the San Fernando Valley.

TELEPHONE AND TELEGRAPH.

ANBURN, CAL.—Farmers of the Mt. Vernon and Edgewood districts have decided to install a new telephone line from Auburn to a point about two miles beyond Mr. Vernon.

MARYSVILLE, CAL.—The residents of the Oregon House, Dry Creek and Dobbins section of Yuba county will be served by a new farmers' telephone line, which will be built shortly.

MAGDALENA, N. M.—The Forest Service has definitely arranged to establish a wireless station at this place, and a similar station at Aragon, N. M. The sending capacity of these stations will not be less than 100 miles.

DENVER, COLO.—At the annual meeting of the Mountain States Telephone & Telegraph Company $3,950,000 was voted for extension and betterments of the system to be carried out this year. The meeting was held at the general offices here. The annual report showed the net income of the company for the year 1915 at $2,316,175.

TRANSPORTATION.

CALDWELL, IDAHO.—Electrification of the Oregon Short Line branch from Caldwell to Wilder, a distance of 12 miles, is to be financed by the business men of Caldwell and farmers along the line through a bond issue of $25,000. Subscriptions for bonds exceeded the amount asked for. The branch has been leased by the Caldwell Traction Company, and will be operated in connection with the company's present system. Officials of the company declare that the line will be in operation within 30 days after the arrival of material necessary for the electrification.

LOS ANGELES, CAL.—Preliminary work has started on the Pacific Electric elevated track scheme which, when it is completed, is expected to reduce railway congestion on Main street by 50 per cent. The two main line tracks, which run through the building from Main street onto the elevated structure, now used will not be disturbed. This elevated track will be extended to San Pedro street. On its north side an additional viaduct will be constructed, which will hold five tracks side by side. The elevated will narrow east of Maple avenue and the five tracks will be reduced to two. The elevated will take care of the north, east and south traffic of the Pacific Electric, including Pasadena, Monrovia, Azusa, San Bernardino, Santa Ana, Long Beach and San Pedro. The main tracks, which run into the building from Main street, will handle the Glendale and some other traffic.

WATERWORKS.

TWIN FALLS, IDAHO.—At the recent election the people of Twin Falls voted in favor of the $80,000 bond issue for taking over the present water system.

SEATTLE, WASH.—A permit has been granted by the county commissioners to the Lake Forest Light, Water & Power Company to lay water pipes in the Lake Forest Park Addition.

EL CENTRO, CAL.—The city trustees and business men are seriously considering submitting at the spring election a bond issue to install a filtration system for water here, at an estimated cost of $35,000.

POCATELLO, IDAHO.—The village of McCammon has sold to James N. Wright & Co. of Denver the $22,000 worth of water bonds of that town, and the construction of the water system will begin at once.

HOOD RIVER, OREGON—At the annual meeting of the Farmers' Irrigating Company the board of directors were instructed to appoint a committee with authority to proceed to finance the development of the power site at their intake on Hood River.

CANBY, ORE.—Canby is considering a municipally owned water system, to be acquired either by purchase of the present M. J. Lee plant or by building a new system. Members of the council are in favor of issuing bonds and building a new system, at the cost of $15,000.

ROSEBURG, ORE.—The Yoncalla city council has passed an ordinance calling for a special city election, to be held April 17th, for the purpose of voting bonds in the sum of $20,000 for the construction of a city water system. The survey for the system has already been made.

ANAHEIM, CAL.—At a meeting of the directors of the Anaheim Union Water Company the superintendent and engineer were appointed a committee, with power to act, to secure a site and install a pumping plant in the river where the water can be furnished to stockholders until repairs on the ditches are completed.

OATMAN, ARIZ.—It is reported that a movement is under way to provide Oatman and neighboring towns and mines with a one and a half million gallon capacity waterworks. Plans provide for a reservoir, the supply to be drawn from wells near the Colorado River. Pumps will force the water through a 10 in. pipe 12 miles.

PORTLAND, ORE.—Bids will be received by the City Auditor until March 9th for the purchase of $125,000 worth of water bonds of the City of Portland, in denominations of $1000 each, payable 25 years from date and bearing 4 per cent interest. The sale is for the purpose of raising funds for the construction of water mains, laterals and for the purchase of meters.

RICHMOND, CAL.—Representatives of the Snow Mountain Water & Power Company appeared last week before the Richmond Water Commission and presented their proposition for a water supply for the city. The $6,000,000 required to handle the supply was too large for the district and the proposition was not seriously considered. The report of Engineer J. H. Dockwieler will be ready for the board about the first of April.

SANTA MONICA, CAL.—Petitions are being circulated for another bond election for the purchasing of four water companies. The attempt made some time ago failed by a small margin. The movement is being promoted by the Municipal Ownership League, which also favors securing Owens River water, either with or without annexation. The water companies have refused to reduce their figures stated in the last election at $750,000.

SAN DIEGO, CAL.—The city council has voted to divert immediately $75,000 of bond money to the construction of a pipe line from Upper to Lower Otay. The line will cost about $30,000, and the remainder of the fund will go toward the construction of a pipe line from Dulzura Creek to Upper Otay. Voters will be asked at an election to consent to the diversion of approximately $114,000 remaining in San Diego River development bond fund to build a pipe line from Dulzura Creek to Upper Otay and repair the conduit from Morona reservoir to the head of Dulzura Creek.

CALIFORNIA STATE WATER COMMISSION. APPLICATIONS.

The Cheney Slough Irrigation Company of Colusa has applied for permission to appropriate 200 second feet of water from the Sacramento River within the borders of the old Jimeno Rancho. A pumping plant of three or four separate units is proposed to lift the water from the river, pumping into a main canal 10 miles in length, from which the water is distributed over approximately 10,000 acres. The estimated cost of the plant is $50,000.

The Atascadero Mutual Water Company of Atascadero, San Luis Obispo County, has applied to appropriate 30 second feet from the Salinas River for irrigation and municipal purposes. The plans call for three pumping plants, each capable of seven million gallons a day, pumpage to be direct from wells in the bed of the river into the mains. There is a contemplated storage reservoir to hold 60,000 acre feet, with dams of rock fill construction to impound the water. In addition to furnishing a municipal supply, it is intended to irrigate some 23,000 acres of land. The estimated cost of the plant is fixed at $750,000.

Robert L. Hargrove, J. G. Roberts and E. M. McCardle, as trustees for the proposed Madera Irrigation District, have filed an application asking for the appropriation of 5000 second-feet of the waters of the San Joaquin River, Fresno and Chowchilla Rivers, Cottonwood, Sand, Hildreth, Dry and Mariposa Creeks, for the purposes of irrigation of some 400,000 acres of land. There is contemplated a dam 230 feet high, of concrete, with ten storage reservoirs, with a capacity of 380,000 acre feet, and a main ditch 45 miles in length. The estimated cost to put the water on the land is given at the extremely low figure of $10 per acre.

The James Mills Orchards Company and the Esperanza Land Corporation of New York, with California headquarters at Hamilton, Colusa County, has applied for permission to appropriate 20 second feet of the waters of Stone Corrall Creek, Colusa County, tributary to Colusa Basin, for agricultural purposes. The companies intend to install pumping plants for the irrigation of about 5000 acres.

T. M. O'Keefe of Palo Credo has applied for permission to appropriate 25 second feet of the waters of the main Cow Creek, in Shasta County. The intention is to divert the water by means of a timber and rock dam into a canal 6½ miles long and carry same to 1444 acres. The estimated cost is $10,000.

The La Mesa, Lemon Grove and Spring Valley Irrigation District of La Mesa, San Diego County, has applied for permission to appropriate 100,000 miner's inches of the waters of San Diego River in that county, flood waters, and 5000 inches of the natural flow for purposes of irrigation and municipal use. There is proposed for the system a storage dam 103 feet high, a storage reservoir with a capacity of 34,000 acre feet, and a pipe line 2½ miles long. It is intended to irrigate approximately 15,000 acres, the plant to have an estimated cost of $1,232,500.

The Oak Creek Land & Water Company of San Francisco has applied for permission to appropriate 70 second feet of the waters of Oak Creek, near Mojave, in Kern County. There is proposed a dam 120 feet high, a storage reservoir capable of holding 50,000 acre feet, a main ditch 7½ miles long to water 61,440 acres, at an estimated cost of $600,000.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co..
Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co.....
673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 4
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 3
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co.....
Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 5
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... 3
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 10
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co..... 12
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 10
441 Golden Gate Ave., San Francisco.

E-4 Electric Storage Battery Co.....
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery St., San Francisco; Colman Bldg., Seattle.

E-5 Electric, Railway & Manufacturing Supply Co..... 10
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co.....
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric).....
618 Mission St., San Francisco.

G-1 General Electric Co.....11-12-13
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co.....
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Wire Co.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 10
330 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 Hunt, Mirk & Co.....
141 Second St., San Francisco.

H-7 Hurley Machine Co..... 2
New York and Chicago.

I-1 Indiana Rubber and Insulated Wire Co..... 14
Fobes Supply Co., Portland and Seattle.

L-1 Leahy Manufacturing Co..... 3
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... 3
Sunnyvale, Cal.

M-4 Morse Chain Co.....
Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... 14
Cleveland, Ohio.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co.....
(All Jobbers.)

N-4 New York Insulated Wire Co.....
629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad.....
808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 14
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.....
80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 90 Seventh St., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 10
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 4
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co..... 14
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....
211 J St., Sacramento; 356 Market St., San Francisco.

S-3 Simplex Electric Heating Co..... 14
612 Howard St., San Francisco.

S-4 Southern Pacific Co..... 4
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 10
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R.....
(See Western Electric Co.)

T-2 Tubular Woven Fabric Company.....
Pawtucket, R I.

W-2 Western Electric Co.....
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 Westinghouse Electric and Manufacturing Co..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co.....
141 Second St., San Francisco.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.